ARBORICULTURAL ASSESSMENT AND IMPACT REPORT

WEST QUAYS
SYDNEY HARBOUR FORESHORE

PREPARED FOR SYDNEY HARBOUR FORESHORE AUTHORITY

13 OCTOBER 2010

Prepared by:
Guy Paroissien
Landscape Matrix Pty Ltd.
ABN 53 110 564 102
T/F. 9943 6510, M. 0425 342 051
40 Timbarra Road St Ives NSW 2075
E-mail: landscapematrix@optusnet.com.au

CONTENTS

EXECUTIVE SUMMARY

Landscape Matrix Pty Ltd has been engaged by Sydney Harbour Foreshore Authority (the Authority) to prepare an Arboricultural Assessment and Impact Report for trees at First Fleet Park at the West Quays precinct of the Sydney harbour foreshore.

The site is located between the Sydney CBD, George Street and Sydney Harbour with the vegetation/trees located in 15 discrete landscape or garden areas.

A total of 179 trees have been identified/assessed for this report with the most common species being *Livistona australis* (Cabbage Tree Palm), *Phoenix roebelenii* (Pigmy Date Palm), *Jacaranda mimosifolia* (Jacaranda), *Washingtonia robusta* (Mexican Fan Palm) and *Macrozamia spp*. (Cycad) - 13 specimens

The majority of trees are mature specimens in good health. While the overwhelming majority of trees, individually, are of low to moderate landscape significance the mature Pepper trees adjacent and parallel to the George Street frontage of the site are of high landscape significance and, collectively, are a the most dominant landscape planting.

None of the trees assessed for the report are listed individually as a threatened species under the NSW *Threatened Species Conservation Act 1995* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

A number of trees exhibited severe suppression and atypical form due to exposure to salt laden winds or proximity to other trees/structures.

To facilitate construction of the landscape and construction works the greater majority of the trees will require removal of transplanting. It is understood the 59 specimens of *Livistona australis* (Cabbage Tree Palm) are proposed to be transplanted and retained on-site and the 13 specimens of *Washingtonia robusta* (Mexican Fan Palm) are proposed to be transplanted off-site.

In addition to the above 4 mature Pepper trees are proposed for retention in the immediate vicinity of a new retaining wall and an elevated deck area leading from George Street into First Fleet Park.

An assessment of the potential impacts on these trees is provided, together with recommended measures to minimise the impacts on the trees. In addition, specific tree protection measures are identified in Appendix E with respect to protection of the 4 Pepper Trees.

1. BACKGROUND

1.1 Landscape Matrix Pty Ltd has been engaged by Sydney Harbour Foreshore Authority (the Authority) to prepare an Arboricultural Assessment and Impact Report for trees at First Fleet Park at the West Quays precinct of the Sydney harbour foreshore.

1.2 The Authority is in the process for preparing a landscape/development plan for the West Quays precinct. Specifically, the Authority is seeking a report that addresses the following key outcomes:

- Site inspection and assessment of trees potentially impacted by the proposed works;
- Broad assessment of the trees with comments regarding the general health, vigour, condition and landscape significance of the trees as groups of trees or species;
- Analysis of the species present to determine if any are listed as threatened species under the NSW *Threatened Species Conservation Act 1995* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
- Preliminary assessment of fauna values/usage of the trees;
- Individual assessment of the Peppercorn Trees along George Street;
- Assessment of the potential impact of the proposed development works on the Peppercorn Trees proposed for retention in the vicinity of works;
- Recommended tree protection measures for the Peppercorn trees to be retained in the vicinity of works.

Apart from the Pepper trees adjacent to George Street the scope of the report is to provide a more general or overview of the trees as detailed information is already held by the Sydney Harbour Foreshore Authority for each of the trees in the precinct.

1.4. The location of the West Quays precinct is illustrated in figure 1 as follows:

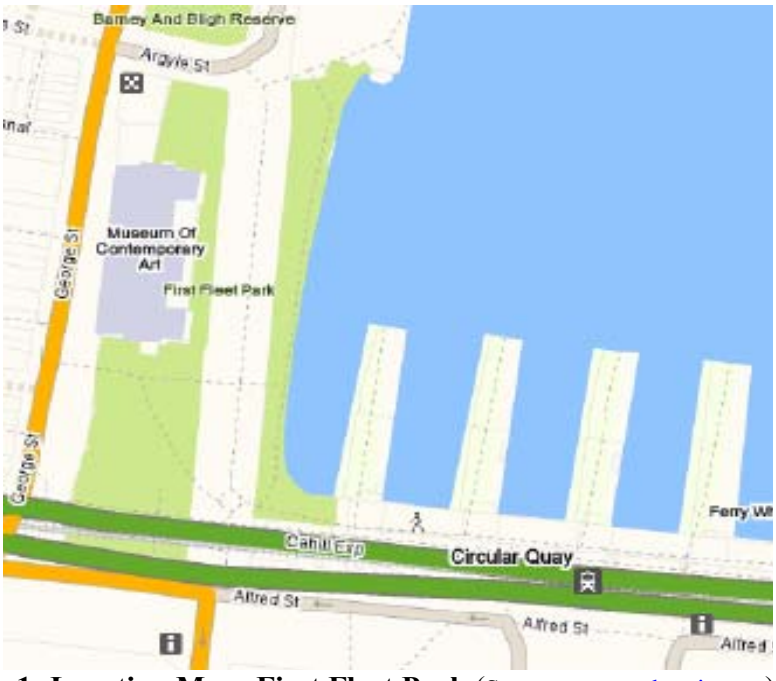


Figure 1: Location Map: First Fleet Park (Source: www.whereis.com)

2. METHODOLOGY

2.1 Site inspections were undertaken on the 20th and 23rd of September 2010 to collect general data for the landscape groups of trees in First Fleet Park and specific data for the Pepper trees in the park adjacent and parallel to George Street. The data for trees was then combined and has been used to assess various aspects of the Pepper trees and the other groups of trees in relation to health, condition, landscape value and retention value. A number methodologies were used in this process.

2.2 The methodologies used in preparation of this report comprised 4 distinct areas. These are:

- Tree health and condition;
- Landscape value or significance;
- Tree retention values; and
- Tree protection zones.

2.3 TREE HEALTH AND CONDITION

The tree health and condition assessment was based upon a visual inspection of the trees from ground level using aspects of the Visual Tree Assessment (VTA) method described by Mattheck & Breloer (1994). The visual inspection included examination of the trees' dimensions, foliage density and foliage health, form, structure, structural condition, overall health and vigour and landscape significance.

The inspection was limited to visual inspection of the trees without dissection, probing or coring. No aerial inspection of the trees was carried out and the assessment did not include any significant woody tissue testing or root investigation.

The tree heights and canopy spreads were estimated and are expressed in metres and the tree diameters at breast height (DBH) were measured with a with standard metal tape at 1.4 metres above ground level and are expressed in millimetres. DBH were rounded up to the nearest 5mm increment.

2.4. LANDSCAPE VALUE OR SIGNIFICANCE

The landscape value or significance of a tree in the landscape is a critical step in the process of determining the importance that a particular tree may have on a site. However, determining tree significance can be a subjective process unless a consistent basis is established to guide the rating.

A number of rating systems have been developed in the past including, for example, the rating system identified in British Standard 5837-2005 (BSI 2005). Typically, these rating systems consider criteria such as size, form, health, heritage, historical and ecological values to assist in determining a rating for the tree.

The Institute of Australian Consulting Arboriculturists (IACA) has developed a draft rating system for assessing tree significance. This draft rating system is attached at appendix D and provides the following rating choices based on a selection of criteria:

- High Significance in the Landscape
- Medium Significance in the Landscape
- Low Significance in the Landscape

Trees need to meet 3 criteria to be selected in that rating in the system developed by IACA. (IACA 2010)

The draft system developed by IACA has been used as a guide to rate the landscape value or significance of trees asses for this report. However, the following modifications have been made:

- A fourth category (after Low landscape significance) of Environmental or Noxious Weed has been added; and
- 'Medium Landscape Significance' has been changed to 'Moderate Landscape Significance'
- Where considered appropriate, a rating between 2 categories has been allowed - e.g. 'Moderate to High Landscape Significance'.

2.5. RETENTION VALUES

Determining the retention value of trees on a development site requires the synthesis of baseline data and subsequent categorisations of individual trees to provide a relative retention value when compared with other trees on the site. The two principal criteria used in determining the retention value of a tree are its sustainability or projected lifespan in the landscape (e.g. SULE) and the tree's landscape value rating.

A number of table or 'matrix' style methods have been successfully used by various authors to assist in consistently determining the retention values of trees on development sites (e.g. Morton 2010, Couston and Howden 2001).

The Institute of Australian Consulting Arboriculturists (IACA) has developed a draft system for assessing tree retention values. This draft system is referred to as 'Tree Retention Value - Priority Matrix and compares life expectancy with landscape significance to identify the following retention values:

- Priority for retention;
- Consider for retention;
- Consider for removal; and
- Priority for removal

The draft system developed by IACA has been used to guide determination of retention values for this report with the following changes to the methodology:

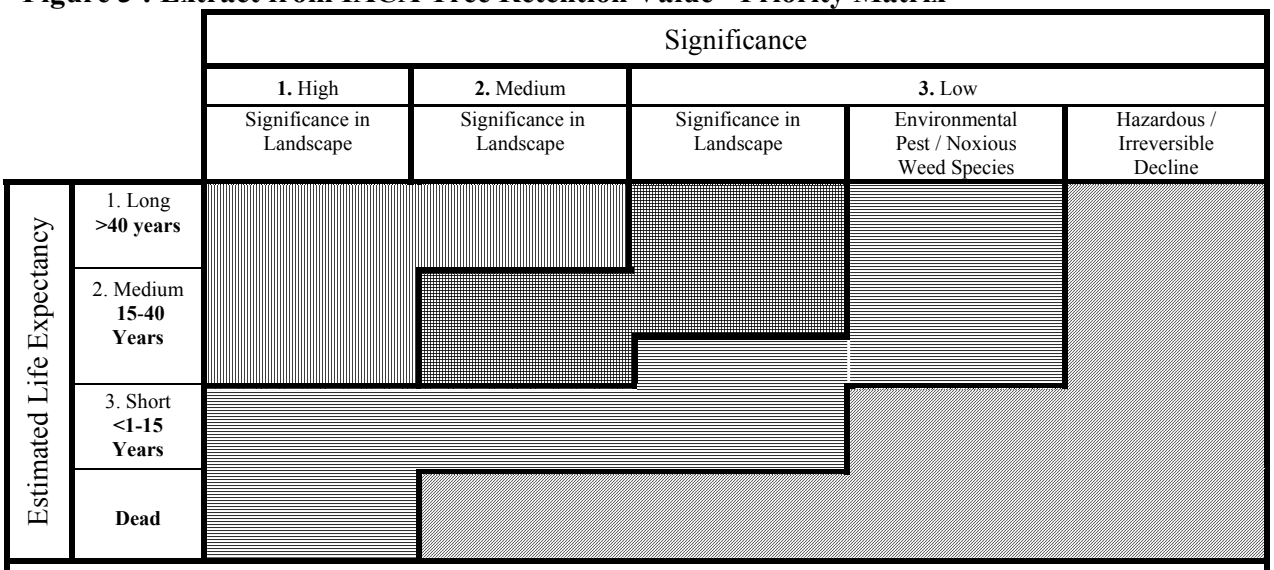
- An additional category has been added - the additional category is for those trees not identified for retention or removal - this provides for those trees that may be of low or low to moderate landscape significance but could be considered for

retention, particularly in the short term, if redevelopment of the site is undertaken and other vegetation is removed.

- Trees of high landscape significance and medium to long SULE identified as the priorities for retention (i.e. trees of moderate landscape significance and long SULE are not identified as a priority for retention due to their moderate significance); and
- Only those trees with a SULE of less than 5 years and those trees identified as structurally unstable are recommended for removal.

The following table is an extract from the IACA Tree Retention Value - Priority Matrix which illustrates the matrix system.

Figure 3 : Extract from IACA Tree Retention Value - Priority Matrix



Legend for Matrix Assessment

	Priority for Retention (High) - These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by the Australian Standard AS4970 *Protection of trees on development sites*. Tree sensitive construction measures must be implemented e.g. pier and beam etc if works are to proceed within the Tree Protection Zone.
	Consider for Retention (Medium) - These trees may be retained and protected. These are considered less critical; however their retention should remain priority with removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.
	Consider for Removal (Low) – These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.
	Priority for Removal – These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.

Source IACA (2010)

2.6. TREE PROTECTION ZONES

A number of methods to determine the likely extent of root zones and appropriate setbacks for tree root protection zones for trees on development sites have been developed in the past. The key criteria used in determining setbacks is the tree's trunk diameter at breast height (DBH) in conjunction with other factors including the sensitivity of the species in question to environmental disturbance/change, the age of the tree and the tree's health and vigour at the time.

Harris et al (2004) provide formulae for calculating tree protection zones based on the above criteria and modified from the 1991 British Standard for protection of trees on construction sites (BS 5837:1991). The 2005 version of the British Standard (BS 5837:2005) recommends a radius of 12 times the tree's DBH. For multi trunked trees BS 5837:2005 recommends a setback of 10 times the basal trunk diameter.

The Australian Standard AS 4970-2009 Protection of Trees on Construction Sites also identifies a 'Tree Protection Zone' (TPZ) of 12 times the tree's DBH. AS 4790-2009 also provides a formula for calculating the "Structural Root Zone' of trees on development sites. This is the area required for stability. In regard to palms, other monocots, cycads and tree ferns the Standard identifies the Tree Protection Zone should not be less than 1 metre outside the crown projection. (Australian Standards Association 2009)

The tree protection zones identified in this report have been calculated using the Australian Standard 'AS 4970 Protection of trees on construction sites' and are the setback from the trees where disturbance (e.g. soil level changes, compaction, excavation etc) must be minimised to reduce potential impacts on the long term health of the trees. The zones have been rounded to the nearest tenth of a metre.

These zones are illustrated in Appendix D which contains an extract (figure 2) from AS4970-2009.

Preferably, no more than 10% of the tree protection zone should be disturbed with compensation made by extension of other areas of the TPZ to compensate for the area(s) disturbed. Where greater than 10% of the tree protection zone is potentially disturbed the tree's viability needs to be investigated and demonstrated by the project arborist. The structural root zone is the area required for stability and where disturbance of any sort should be avoided.

3. TREE ASSESSMENT RESULTS

3. 1 Brief Summary of trees assessed for the report

During the site inspections undertaken in 20th and 23rd of September 2010 a total of 15 landscape areas or units and 8 Pepper trees at the West Quays precinct were assessed. In regard to the 15 landscape areas data regarding the general health, vigour, condition and landscape significance of the trees as groups of trees or species was collected. Specific data was collected for each of the Pepper Trees. This data is summarised in Appendix B – Summary Data Sheets for areas 1 to 15 and the Tree Data Summary for the 8 Pepper trees.

The 179 trees assessed for the report are summarised in table 1 as follows:

Table 1: Summary of species present, number and height range

SPECIES	COMMON NAME	NUMBER PRESENT	HEIGHT RANGE (metres)
Corymbia citriodora	Lemon Scented Gum	1	16
Eucalyptus botryoides	Bangalay	1	13
Jacaranda mimosifolia	Jacaranda	21	5 to 9
Livistona australis	Cabbage Tree Palm	59	4 to 9
Rainforest Sp	Rainforest Sp	1	13
Lophostemon confertus	Brushbox	2	8 to 10
Macadamia integrifolia	Macadamia Tree	3	5 to 6
Macrozamia spp.	Cycad	13	Up to 1.8
Phoenix roebelenii	Pygmy Date Palm or Miniature Date Palm	37	Up to 3
Unidentified Species	Unidentified Species	3	Up to 3
Schinus areira	Pepper Tree, Peruvian Mastic Tree	9	8 to 14
Washingtonia robusta	Washington Palm	15	5.5 to 13
Cyathea australis	Rough Tree Fern	1	3
Celtis chinensis	Chinese Hackberry	4	12 to 18
Lophostemon confertus	Brushbox	2	8 to 10
Fraxinus griffithii	Evergreen Ash	3	3.5 to 4
Magnolia grandiflora cv	'Little Gem' Magnolia Cultivar	4	2.5 to 3
	Total	**179**	**2.5 to 18 metres**

The locations of the 15 landscape areas and the 8 individual Pepper trees are identified in Figure 2 – Site Plan with Tree Locations.

INSERT FIGURE 2 – SITE PLAN WITH LANDSCAPE AREA/TREE LOCATIONS

3. 2 Observations regarding the site

The following observations are made in regard to the site:

- The site is located between the Sydney CBD, George Street and Sydney Harbour;
- The Museum of Contemporary Art (MCA) building is the major structure in the site;
- The site is subject to salt laden winds from the adjacent Sydney Harbour; and
- The vegetation/trees are located in 15 discrete landscape or garden areas with a 16th area to the north of the MCA building cleared of vegetation in the recent past for construction works.
- 5 species of birds were noted using the site during the inspections being the following species: Rainbow Lorikeet (*Trichoglossus haematodus*), Noisy Miner (*Manorina melanocephala*), Silver Gull (*Larus novaehollandiae*), Australian White Ibis (*Threskiornis molucca*) and Feral Pigeon (*Columba livia*).
- The presence of numerous rodent traps indicates the pest species of rats and mice at the site.

Figure 3: Illustrating the site as viewed from George Street.

3. 3 Observations regarding the trees assessed for the report

The following general observations are made in regard to the trees assessed for this report:

- 179 trees have been identified/assessed for this report;
- The most common species present are:
    - *Livistona australis* (Cabbage Tree Palm) - 59 specimens
    - *Phoenix roebelenii* (Pigmy Date Palm)
    - *Jacaranda mimosifolia* (Jacaranda) - 21 specimens
    - *Washingtonia robusta* (Mexican Fan Palm) - 15 specimens; and
    - *Macrozamia spp*. (Cycad) - 13 specimens
- In addition to the above there were 4 specimens of the environmental weed species *Celtis chinensis* (Chinese Hackberry) present at the site. These trees are adjacent to the southern side of the MCA building.
- The majority of trees are mature specimens;
- The majority of the trees are in good health;
- The overwhelming majority of trees, individually, are of low to moderate landscape significance;
- The mature Pepper trees adjacent and parallel to the George Street frontage of the site are of high landscape significance and, collectively, are a the most dominant landscape planting.
- None of the trees assessed for the report are listed individually as a threatened species under the NSW *Threatened Species Conservation Act 1995* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
- While 5 species of birds were noted during the site inspections, none of the trees exhibited specific signs of usage by wildlife such as scratch marks on the trunks or nest remnants in the canopy.
- The Jacaranda trees in particular exhibited severe suppression and atypical form due to exposure to salt laden winds.

Figure 3: Illustrating the severe suppression and atypical form of Jacarandas in landscape unit/area 12.

4. TREE RETENTION VALUES AND TREE PROTECTION ZONES

4.1 Introduction and Summary

Using the methodologies referred to in section 2 of this report the trees can be categorised according to a number of criteria. Of particular interest is the criteria related to:

- Health
- Maturity
- Landscape Significance; and
- Safe Useful Life Expectancy (SULE)

By combining assessment criteria it is possible to identify those trees to which greater consideration should be given in the design process. For example, those trees that are identified as being of both medium to long SULE and high landscape significance should be the first priority for retention in the design process. In contrast those trees of high landscape significance but short SULE should not be a significant consideration in the design process as they would only be suitable for retention in the short term.

The same principle can be used to identify those trees of moderate or moderate to high landscape significance and medium to long SULE as trees that should be considered for retention if possible in the design process.

In addition, this process can be used to identify trees that should be removed from the site, regardless of any development proposals, due to declining health, structural issues (e.g. risk of failure) or unsuitability to the site (e.g. invasive weed species).

Using this process of categorisation for the tress assessed has identified that tree numbers 1 to 6 of the 8 Pepper trees located adjacent and parallel to the George Street frontage of the site are of high landscape significance and medium SULE. The remaining 2 Pepper trees in this group (tree numbers 7 and 8) were identified as being of moderate to high landscape value.

The significance of species/groups of plants in the landscape units/areas 1 to 15 were assessed as follows:

Area 1: Low to moderate significance
Area 2: Low to moderate significance
Area 3: Low to moderate significance
Area 4: Low to moderate significance, 1 x Jacaranda of moderate to high significance
Area 5: Low to moderate significance, 1 x Lemon Scented Gum of moderate to high significance
Area 6: Low to moderate significance
Area 7: 6 Pepper Trees of high significance, 2 Pepper Trees of Moderate to high significance

Area 8: A group planting of 13 Mexican Fan Palms - moderate significance individually, high as a group planting
Area 9: Low to moderate (visually high Hackberry present but this species is a weed species)
Area 10: Low to moderate (visually high Hackberry present but this species is a weed species)
Area 11: Low to moderate significance
Area 12: Low to moderate significance
Area 13: Low significance
Area 14: Low to moderate significance, 1 x Jacaranda of moderate to high significance
Area 15: Moderate significance, 1 x Jacaranda of moderate to high significance

The locations of the above landscape units/area are shown on figure 2 of this report.

Once trees have been identified for retention it is important to identify the spatial constraints to development that retention of the trees will require. The spatial constraints relate to protection of a minimum area required for the root zone requirements of the tree and protection of the trees' existing/future canopy growth.

4.2 Tree Protection Zones - Pepper Trees

The tree protection zones required for the 8 Pepper Trees adjacent and parallel to the George Street frontage of the site have been derived using the criteria specified in AS4970-2009 and are identified in table 2 below.

Table 2: Tree Protection Zones - Pepper Trees

Tree Number	Species and Common Name	Tree Protection Zone	Structural Root Zone
1	*Schinus areira* (Pepper Tree, Peruvian Mastic Tree)	14.4 metres	3.9 metres
2	*Schinus areira* (Pepper Tree, Peruvian Mastic Tree)	7.6 metres	2.9 metres
3	*Schinus areira* (Pepper Tree, Peruvian Mastic Tree)	10.4 metres	3.6 metres
4	*Schinus areira* (Pepper Tree, Peruvian Mastic Tree)	9.4 metres	3.2 metres
5	*Schinus areira* (Pepper Tree, Peruvian Mastic Tree)	8.6 metres	3.4 metres
6	*Schinus areira* (Pepper Tree, Peruvian Mastic Tree)	6.7 metres	2.8 metres
7	*Schinus areira* (Pepper Tree, Peruvian Mastic Tree)	7.2 metres	2.8 metres
8	*Schinus areira* (Pepper Tree, Peruvian Mastic Tree)	7.9 metres	3.3 metres

Specific tree protection measures are identified in Appendix E to provide guidance on likely measures that will be required prior to and during the construction process to minimise risk of damage to the Pepper trees proposed for retention.

5. IMPACT ANALYSIS OF PROPOSED WORKS

5.1 Trees requiring removal or proposed to be removed to facilitate the proposed landscape and construction works

To facilitate construction of the landscape and construction works the following tree/plant removals are proposed works:

- Removal or transplanting of all plants in the landscape units/areas 1 to 15
- Removal of 4 of the 8 Pepper Trees adjacent and parallel to the George Street frontage of the site (numbers 5, 6, 7 and 8)

It is understood the 59 specimens of *Livistona australis* (Cabbage Tree Palm) are proposed to be transplanted and retained on-site and the 13 specimens of *Washingtonia robusta* (Mexican Fan Palm) are proposed to be transplanted off-site. It may also be possible to transplant the Pigmy Date Palms and Cycads off-site.

5.2 Trees potentially impacted by the proposed landscape and construction works

To facilitate construction of the proposed landscape and construction works 4 mature Pepper trees are proposed for retention in the vicinity of works and may be potentially impacted. These 4 trees are summarised in table 3 as follows:

Table 4: Trees potentially affected by the proposed landscape and construction works

TREE NUMBER(S)	SCIENTIFIC AND COMMON NAME	COMMENTS*
1	*Schinus areira* (Pepper Tree, Peruvian Mastic Tree)	A mature, single trunked specimen approximately 13 metres in height with a canopy spread of 16 metres and a diameter at breast height (DBH) of 1200mm. In good health and of high landscape significance. The tree displays signs of instability with an extensive hollow and evidence of past decay in pruning wounds on the south side of the trunk at 1 and 1.5 metres - the decay in the lower hollow extends at least 1.5 metres downwards into the basal trunk area and the upper hollow extends at least 400mm into the trunk - further invasive testing (e.g. Resistograph test) is required to enable an informed decision regarding the tree's structural integrity.
2	*Schinus areira* (Pepper Tree, Peruvian Mastic Tree)	A mature, single trunked specimen approximately 12 metres in height with a canopy spread of 10 x 12 metres and a DBH of 630mm. In good health and of high landscape significance.

3	*Schinus areira* (Pepper Tree, Peruvian Mastic Tree)	A mature, twin trunked specimen approximately 12 metres in height with a canopy spread of 11 x 17 metres and DBH of 520 and 640mm. In good health and of high landscape significance. The tree displays signs of instability with evidence of decay in a large diameter pruning wound at 1 metre on the SW side of the NW leader - further investigation and monitoring is recommended.
4	*Schinus areira* (Pepper Tree, Peruvian Mastic Tree)	A mature, single trunked specimen approximately 12 metres in height with a canopy spread of 13 metres and a DBH of 780mm. In good health and of high landscape significance. There is limited decay present in pruning wounds at 0.4 and 1.5 metres on the west/southwest side of the tree - appears sound - further investigation and monitoring is recommended.

The above 4 trees are proposed for retention in the immediate vicinity of a new retaining wall and an elevated deck area leading from George Street into First Fleet Park. The extent of impacts to the trees in table 4 has been rated using the following guideline:
0% of root zone impacted – no impact of significance
0 to 10% of root zone impacted – low level of impact
10 to 15% of root zone impacted – low to moderate level of impact
15 to 20% of root zone impacted – moderate level of impact
20 to 25% of root zone impacted – moderate to high level of impact
25 to 35% of root zone impacted – high level of impact
> 35% of root zone impacted – significant level of impact

Table 4: Impacts of the proposed landscape and construction works

TREE NUMBER(S)	SCIENTIFIC AND COMMON NAME	COMMENTS*
1	*Schinus areira* (Pepper Tree, Peruvian Mastic Tree)	The new retaining wall is located 5.8 metres from the tree at the closest point and is at a greater offset than he existing sandstone wall - as the existing wall is within the tree's identified structural root zone (SRZ) is recommended any below ground sections of the wall be retained in situ as they will almost certainly form part of the tree's structural support. There are support piles for the new deck area located 1.5, 1.8, 2.98 and 2.99 metres from the tree and within the tree's structural root zone - the locations of the piles will need to be identified through non destructive methods to ensure structural roots are not disturbed or damaged (e.g. air knife excavation). The proposed concrete deck area will cover 142.8m^2 or 21.93% of the tree's identified protection zone (TPZ) that is currently garden area or soft landscape (mulched or grassed area) While this is considered to be a moderate to high percentage of TPZ impacted the actual impacts will be reduced as it is an elevated structure supported by isolated piers. It is also proposed to increase the soil level under the deck starting approximately 1.1 metres from the tree and increasing in depth up to 1 metre in depth at 6 metres from the tree. The extent (depth) of fill will impact on the tree's root zone - it is

		recommended that the extent of soil level increases be restricted to a maximum of 150mm using a coarse grained washed rived sand to minimise impacts to the soil profile/root zone below.
2	*Schinus areira* (Pepper Tree, Peruvian Mastic Tree)	There are 4 support piles for the new deck area located 1.6 metres from the tree and within the tree's structural root zone - the locations of the piles will need to be identified through non destructive methods to ensure structural roots are not disturbed or damaged (e.g. air knife excavation). The proposed concrete deck area will cover 117.36m^2 or 65.40% of the tree's identified TPZ that is currently garden area or soft landscape (mulched or grassed area) While this is considered to be significant percentage of TPZ impacted the actual impacts will be reduced as it is an elevated structure supported by isolated piers. Given the extent of TPZ impacted it is essential that provision is made for ongoing irrigation to the root zone area below the deck and for continued supply of organic matter and nutrients to replicate natural deposition of organic material (leaves, bark, flowers, etc) - it is recommended a specific management plan for the area under the deck be prepared to detail on-going management of the root zone to ensure adequate health of the soil profile for root growth, moisture and nutrient uptake. It is also proposed to increase the soil level under the deck starting approximately 1.1 metres from the tree and increasing in depth up to 1 metre in depth at 6 metres from the tree. The extent (depth) of fill will impact on the tree's root zone - it is recommended that the extent of soil level increases be restricted to a maximum of 150mm using a coarse grained washed rived sand to minimise impacts to the soil profile/root zone below. Given the extent of disturbance it is considered probable the tree's long term health will be impacted and its SULE reduced.
3	*Schinus areira* (Pepper Tree, Peruvian Mastic Tree)	There are support piles for the new deck area located 1.58, 1.7, 1.7 and 3 metres from the tree and within the tree's structural root zone - the locations of the piles will need to be identified through non destructive methods to ensure structural roots are not disturbed or damaged (e.g. air knife excavation). The proposed new retaining wall is located 4 metres from the tree at the closest point and is calculated to potentially impact on 10.49m^2 or 3.07% of the tree's identified TPZ that is currently garden area and a total of 35.6m^2 or 10.4% including the pavement areas of George Street - this is a low to moderate level of impact. The proposed concrete deck area will cover 220.15m^2 or 64.33% of the tree's identified TPZ that is currently garden area or soft landscape (mulched or grassed area) While this is considered to be significant percentage of TPZ impacted the actual impacts will be reduced as it is an elevated structure supported by isolated piers. Given the extent of TPZ impacted it is essential that provision is made for ongoing irrigation to the root zone area below the deck and for continued supply of organic matter and nutrients to replicate natural deposition of organic material (leaves, bark, flowers, etc) - it is recommended a specific management plan for the area under the deck be prepared to detail on-going management of the root zone to ensure adequate health of the soil profile for root growth, moisture and nutrient uptake. It is also proposed to increase the soil level under the deck starting approximately 1.1 metres from the tree and increasing in depth up to 1 metre in depth at 6.7 metres from the tree. The extent (depth) of fill will impact on the tree's root zone - it is recommended that the extent of soil level increases be restricted to a maximum of 150mm using a coarse grained washed rived sand to minimise impacts to the soil profile/root zone below. Given the extent of disturbance it is considered probable the tree's long term health will be impacted and its SULE reduced.

4	*Schinus areira* (Pepper Tree, Peruvian Mastic Tree)	There are 4 support piles for the new deck area located 1.5 to 1.8 metres from the tree and within the tree's structural root zone - the locations of the piles will need to be identified through non destructive methods to ensure structural roots are not disturbed or damaged (e.g. air knife excavation). The proposed new retaining wall is located 2.45 metres from the tree at the closest point. While the wall is proposed to be constructed using pier and beam techniques the section shows a beam sitting at ground level that will require an excavation of approximately 500mm depth. The wall is calculated to potentially impact on 37.57m^2 or 13.66% of the tree's identified TPZ that is currently garden area and a total of 93.14m^2 or 33.86% including the pavement areas of George Street - this is a high level of impact that is considered likely to impact on the tree's short and long term health and reduce its SULE. As the excavations are within the tree's identified structural root zone is it considered probable that structural roots could be affected and the tree's stability compromised - given the high target nature of the site further investigations are required to specifically identify the extent (number and dimensions) of roots that will be affected by the proposed excavation - it is recommended this be undertaken using an air knife under the supervision of the site arborist to enable an assessment of the sustainable retention potential of the tree. The proposed concrete deck area will cover 220.15m^2 or 64.33% of the tree's identified TPZ that is currently garden area or soft landscape (mulched or grassed area) While this is considered to be significant percentage of TPZ impacted the actual impacts will be reduced as it is an elevated structure supported by isolated piers. Given the extent of TPZ impacted it is essential that provision is made for ongoing irrigation to the root zone area below the deck and for continued supply of organic matter and nutrients to replicate natural deposition of organic material (leaves, bark, flowers, etc) - it is recommended a specific management plan for the area under the deck be prepared to detail on-going management of the root zone to ensure adequate health of the soil profile for root growth, moisture and nutrient uptake. It is also proposed to increase the soil level under the deck starting approximately 1.1 metres from the tree and increasing in depth up to 1 metre in depth at 6.7 metres from the tree. The extent (depth) of fill will impact on the tree's root zone - it is recommended that the extent of soil level increases be restricted to a maximum of 150mm using a coarse grained washed rived sand to minimise impacts to the soil profile/root zone below. Given the extent of disturbance it is considered probable the tree's short long term health will be impacted and its SULE reduced. In addition, excavation within the tree's structural root zone has the potential to impact on the tree's stability and further investigation (root mapping) is required.

* Root zone calculations were made using scale drawings of the trees' identified tree protection zones in a CAD program (TurboCAD®) with potentially affected areas added to the drawing.

The level of impact to tree number 1 is considered to be within an acceptable threshold providing the proposed soil level increases within its TPPZ can be minimised. The level of impact to tree numbers 2, 3 and 4 is in a range that is considered likely to affect the trees' long term health and reduce their SULE. The proposed excavation within the structural root zone of tree number 4 has the potential to impact on the tree's stability and further investigation (root mapping) is required. Given the extent of TPZ impacts to the trees it is essential that provision is made for ongoing irrigation to the root zone areas below the deck and for continued supply of organic matter and nutrients to replicate natural deposition of organic material (leaves, bark, flowers, etc) - it is recommended a specific management plan for the area under the deck be prepared to detail on-going management of the root zones to ensure adequate health of the soil profile for root growth, moisture and nutrient uptake.

6. CONCUSIONS

6.1 The site

The site is located between the Sydney CBD, George Street and Sydney Harbour with the vegetation/trees located in 15 discrete landscape or garden areas. There is a 16th landscape area to the north of the Museum of Contemporary Art building that has been cleared of vegetation in the recent past for construction works.

6.2 The trees

A total of 179 trees have been identified/assessed for this report with the most common species being *Livistona australis* (Cabbage Tree Palm), *Phoenix roebelenii* (Pigmy Date Palm), *Jacaranda mimosifolia* (Jacaranda), *Washingtonia robusta* (Mexican Fan Palm) and *Macrozamia spp*. (Cycad) - 13 specimens

In addition to the above there were 4 specimens of the environmental weed species (Chinese Hackberry) present at the site. These trees are adjacent to the southern side of the MCA building. Whilst these trees are visually of high landscape significance it is recommended they be removed due to weed status and future seed source potential.

The majority of trees are mature specimens in good health. While the overwhelming majority of trees, individually, are of low to moderate landscape significance the mature Pepper trees adjacent and parallel to the George Street frontage of the site are of high landscape significance and, collectively, are a the most dominant landscape planting.

None of the trees assessed for the report are listed individually as a threatened species under the NSW *Threatened Species Conservation Act 1995* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

While 5 species of birds were noted during the site inspections, none of the trees exhibited specific signs of usage by wildlife such as scratch marks on the trunks or nest remnants in the canopy.

The Jacaranda trees in particular exhibited severe suppression and atypical form due to exposure to salt laden winds

6.3 Impacts of the proposed landscape and construction works

To facilitate construction of the landscape and construction works the following tree/plant removals are proposed:

- Removal or transplanting of all plants in the landscape units/areas 1 to 15
- Removal of 4 of the 8 Pepper Trees adjacent and parallel to the George Street frontage of the site (numbers 5, 6, 7 and 8)

It is understood the 59 specimens of *Livistona australis* (Cabbage Tree Palm) are proposed to be transplanted and retained on-site and the 13 specimens of *Washingtonia robusta* (Mexican Fan Palm) are proposed to be transplanted off-site. It may also be possible to transplant the Pigmy Date Palms and Cycads off-site

To facilitate construction of the proposed landscape and construction works 4 mature Pepper trees are proposed for retention in the immediate vicinity of a new retaining wall and an elevated deck area leading from George Street into First Fleet Park. These trees are identified as tree numbers 1, 2, 3 and 4.

The level of impact to tree number 1 is considered to be within an acceptable threshold providing the proposed soil level increases within its TPPZ can be minimised. The level of impact to tree numbers 2, 3 and 4 is in a range that is considered likely to affect the trees' long term health and reduce their SULE. The proposed excavation within the structural root zone of tree number 4 has the potential to impact on the tree's stability and further investigation (root mapping) is required.

Given the extent of TPZ impacts to these 4 trees it is essential that provision is made for ongoing irrigation to the root zone areas below the deck and for continued supply of organic matter and nutrients to replicate natural deposition of organic material (leaves, bark, flowers, etc) - it is recommended a specific management plan for the area under the deck be prepared to detail on-going management of the root zones to ensure adequate health of the soil profile for root growth, moisture and nutrient uptake.

Specific tree protection measures are identified in Appendix E with respect to protection of the 4 Pepper Trees.

7. RECOMMENDATIONS

That further invasive testing (e.g. Resistograph Test) of the Pepper Tree identified as tree number 1 be undertaken as a matter of urgency to enable an informed decision regarding the tree's structural integrity.

That a specific management plan for the area under the deck be prepared to detail on-going management of the root zones of tree numbers 1, 2, 3 and 4 to ensure adequate health of the soil profile for root growth, moisture and nutrient uptake.

That the specific tree protection measures identified in Appendix E with respect to protection of the 4 Pepper Trees be implemented as specified.

That all required tree pruning and removal works be undertaken by an AQF level 3 arborist and that the work be carried out in accordance with AS4373:2007 *Pruning of Amenity Trees* and the WorkCover NSW *Code of Practice for the Amenity Tree Industry*.

Guy Paroissien, MAIH, MIACA, MISAAC
M Env. Mgt & Restor., Hort Cert., Tree Care Cert.
Director, Landscape Matrix Pty Ltd
13 October 2010

6. BIBLIOGRAPHY/REFERENCES

Australian Standards Association (2007)
AS 4373- 2007 - *Australian Standard 4373-2007 'Pruning of Amenity Trees'*

Australian Standards Association (2009)
AS 4790- 2009 - *Australian Standard 4790- 2009 'Protection of trees on development sites*'.

Barrell J (1996)
Pre-planning Tree Surveys: SULE is the Natural Progression.
Arboricultural Journal 17, 33-46.

Benson and Howell (1990)
Taken For Granted: The Bushland Of Sydney and its Suburbs. Kangaroo Press (in association with the Royal Botanic Gardens Sydney) Kenthurst, New South Wales, Australia.

Couston M and Howden M (2001)
Tree Protection Values Table - Developed by Footprint Green Pty Ltd and authored by Mark Couston and Melanie Howden.

Harris et al (2004). Harris RW, Clark JR, Matheny NP
Arboriculture – Integrated Management of Landscape Trees Shrubs and Vines 4TH Edition. Prentice Hall, New Jersey 07458.

IACA (2010)
Rating System For Tree Significance - a draft rating system developed by the Institute of Australian Consulting Arboriculturists (IACA) for rating tree significance. Available on the IACA website at: www.iaca.org.au

Morton (2010)
Trees and Development - Session 3 - Assessing Tree Retention Values.
Notes prepared by Andrew Morton NSW TAFE for Diploma in Arboriculture students.

UBD Australia (2006)
UBD Sydney Street Directory. 35th Edition. Published by UBD Australia.

APPENDIX A: APPENDIX B : SUMMARY SHEETS OF MAIN SPECIES PRESENT BY LANDSCAPE AREA

AREA: 1

Species	No. present	Height Range	Maturity	Form	Health and vigour	Evidence of wildlife usage	Landscape significance
Phoenix roebelenii (Pygmy Date Palm or Miniature Date Palm)	12	Up to 3 metres	Mature	Mostly stunted	Moderate to good	Nil	Low
Macrozamia spp. (Cycad)	4	Up to 1.8 metres	Semi mature to mature	Typical /upright	Moderate to good	Nil	Low
Livistona australis (Cabbage Tree Palm)	8	Up to 5.5 metres	Semi mature to mature	Typical /upright	Good	Nil	Moderate
Washingtonia robusta (Washington Palm)	1	5.5 metres	Mature	Typical /upright	Good	Nil	Moderate

AREA: 2

Species	No. present	Height Range	Maturity	Form	Health and vigour	Evidence of wildlife usage	Landscape significance
Phoenix roebelenii (Pygmy Date Palm or Miniature Date Palm)	14	Up to 3 metres		Mostly typical/upright	Good	Nil	Low to moderate
Livistona australis (Cabbage Tree Palm)	8	Up to 5.5 metres	Semi mature to mature	Typical/upright	Good	Nil	Moderate

AREA: 3

Species	No. present	Height Range	Maturity	Form	Health and vigour	Evidence of wildlife usage	Landscape significance
Macrozamia spp. (Cycad)	4	Up to 1.8 metres	Semi mature to mature	Typical	Good	Nil	Low
Phoenix roebelenii (Pygmy Date Palm or Miniature Date Palm)	6	Up to 3.5 metres	Mature	Typical/up right	Good	Nil	Low to moderate
Livistona australis (Cabbage Tree Palm)	11	Up to 4 metres	Semi mature to mature	Typical/up right	Good	Nil	Moderate

AREA: 4

Species	No. present	Height Range	Maturity	Form	Health and vigour	Evidence of wildlife usage	Landscape significance
Jacaranda mimosifolia (Jacaranda)	1	10 metres	Mature	Typical /upright	Good	Nil	Moderate to high
Livistona australis (Cabbage Tree Palm)	14	Up to 9.9 metres	Mature	Typical /upright	Good	Nil	Moderate
Phoenix roebelenii (Pygmy Date Palm or Miniature Date Palm)	1	2.2 metres	Mature	Stunted	Good	Nil	Low
Eucalyptus botryoides (Bangalay)	1	13 metres	Mature	Typical /upright	Moderate	Nil	Moderate

AREA: 5

Species	No. present	Height Range	Maturity	Form	Health and vigour	Evidence of wildlife usage	Landscape significance
Phoenix roebelenii (Pygmy Date Palm or Miniature Date Palm)	3	Up to 2.5 metres	Mature	Typical/up right	Good	Nil	Low to moderate
Livistona australis (Cabbage Tree Palm)	4	Up to 8 metres	Mature	Typical/up right	Good	Nil	Moderate
Schinus areira (Pepper Tree, Peruvian Mastic Tree)	1	8 metres	Mature	Typical/up right	Moderate	Nil	Moderate
Corymbia citriodora (Lemon Scented Gum)	1	16 metres	Mature	Typical/up right	Moderate	Nil	Moderate to high
Lophostemon confertus (Brushbox)	1	8 metres	Semi mature	Typical/up right	Moderate	Nil	Low to moderate
Macadamia integrifolia (Macadamia Tree)	1	5 metres	Mature	Typical/up right	Good	Nil	Low to moderate
Macrozamia spp. (Cycad)	3	Up to 1.5 metres	Semi mature to mature	Typical/up right	Moderate	Nil	Low
Washingtonia robusta (Washington Palm)	1	10 metres	Mature	Typical/up right	Good	Nil	Moderate

AREA: 6

Species	No. present	Height Range	Maturity	Form	Health and vigour	Evidence of wildlife usage	Landscape significance
Phoenix roebelenii (Pygmy Date Palm or Miniature Date Palm)	1	2.5 metres	Mature	Typical /upright	Good	Nil	Low
Macadamia integrifolia (Macadamia Tree)	2	5 to 6 metres	Mature	Typical /upright	Good	Nil	Low to moderate
Lophostemon confertus (Brushbox)	1	10 metres	Semi mature	Typical /upright	Good	Nil	Moderate
Macrozamia spp. (Cycad)	2	Up to 1.5 metres	Semi mature	Typical /upright	Moderate	Nil	Low
Rainforest Sp	1	13 metres	Semi mature	Typical /upright	Good	Nil	Moderate

AREA: 7

Species	No. present	Height Range	Maturity	Form	Health and vigour	Evidence of wildlife usage	Landscape significance
Schinus areira (Pepper Tree, Peruvian Mastic Tree) *	8	12 to 14	Mature	Mostly typical	Mostly good	Nil	High
Livistona australis (Cabbage Tree Palm)	3	3 to 8 metres	Mature	Typical /upright	Good	Nil	Moderate

* See detailed data summary for the 8 Pepper trees

AREA: 8

Species	No. present	Height Range	Maturity	Form	Health and vigour	Evidence of wildlife usage	Landscape significance
Washingtonia robusta (Washington Palm)	13	9 to 13 metres	Mature	Typical /upright	Good	Nil	Moderate individually, high as a group

AREA: 9

Species	No. present	Height Range	Maturity	Form	Health and vigour	Evidence of wildlife usage	Landscape significance
Livistona australis (Cabbage Tree Palm)	3	Up to 8.5 metres	Mature	Typical/up right	Good	Nil	Moderate
Unidentified Sp	2	7 metres	Mature	Typical - upright and spreading	Good	Nil	Moderate
Cyathea australis (Rough Tree Fern)	1	3 metres	Mature	Typical/up right	Good	Nil	Low
Celtis chinensis (Chinese Hackberry)	1	14 metres	Mature	Typical/up right	Good	Nil	High visually, environmental pest species

AREA: 10

Species	No. present	Height Range	Maturity	Form	Health and vigour	Evidence of wildlife usage	Landscape significance
Celtis chinensis (Chinese Hackberry)	3	12 to 18 metres	Semi mature to mature	2 x Suppressed 1 x Typical and upright	Good	Nil	2 x Low to medium 1 x High to significant, but environmental pest species
Unidentified Species	1	3 metres	Semi mature	Stunted	Good	Nil	Low

AREA: 11

Species	No. present	Height Range	Maturity	Form	Health and vigour	Evidence of wildlife usage	Landscape significance
Jacaranda mimosifolia (Jacaranda)	1	8.5 metres	Mature	Typical /upright	Good	Nil	Moderate
Fraxinus griffithii (Evergreen Ash)	3	3.5 to 4 metres	Mature	Typical /upright	Moderate to good	Nil	Low to moderate

AREA: 12

Species	No. present	Height Range	Maturity	Form	Health and vigour	Evidence of wildlife usage	Landscape significance
Magnolia grandiflora cv ('Little Gem' Magnolia Cultivar)	1	2.5 metres	Semi mature	Upright	Good	Nil	Low
Jacaranda mimosifolia (Jacaranda)	7	5 to 8 metres	Mature	Stunted and suppressed by salt laden winds	Fair to moderate	Nil	6 x low, 1 x moderate
Livistona australis (Cabbage Tree Palm)	4	4 to 8 metres	Mature	Typical/ upright	Good	Nil	Moderate

AREA: 13

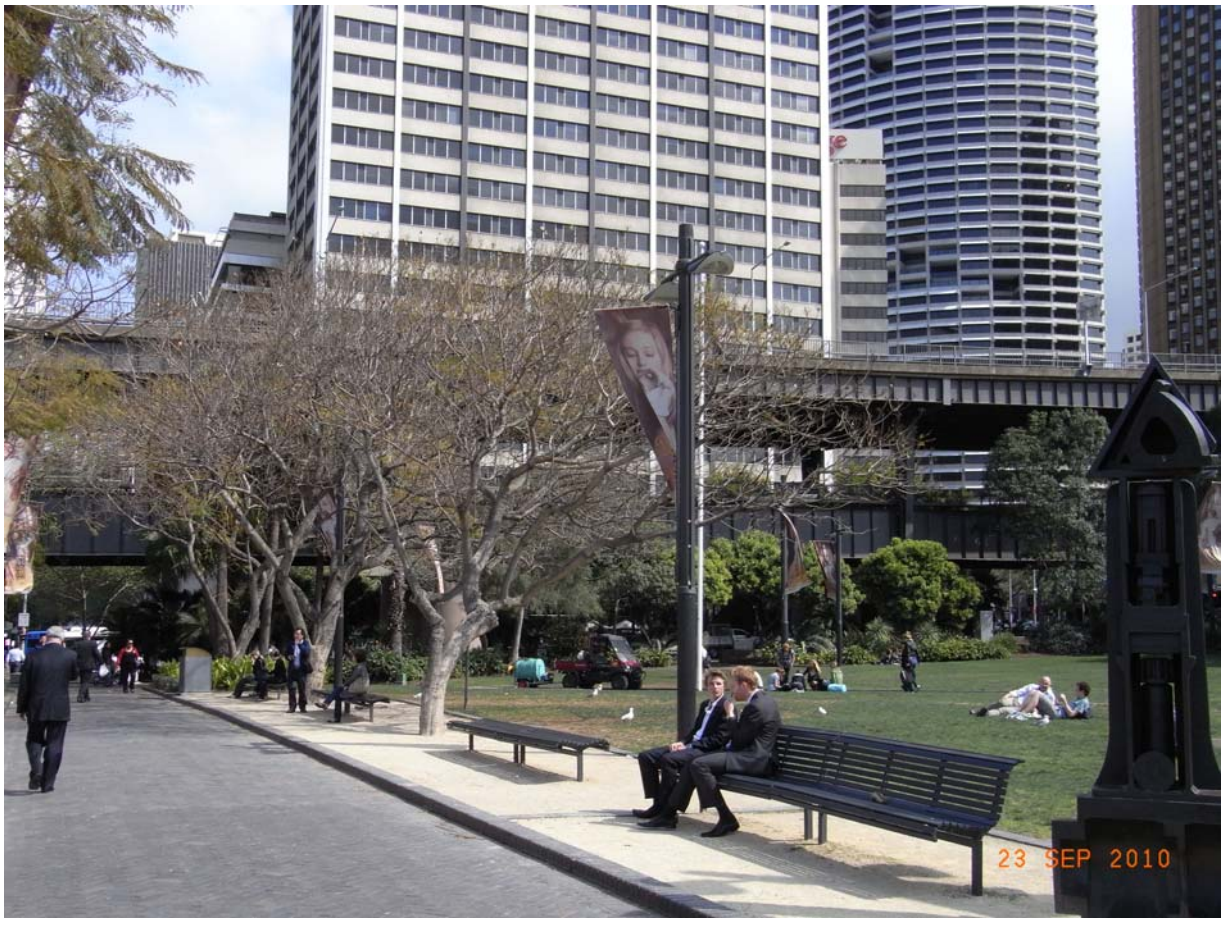
Species	No. present	Height Range	Maturity	Form	Health and vigour	Evidence of wildlife usage	Landscape significance
Magnolia grandiflora cv ('Little Gem' Magnolia Cultivar)	2	3 metres	Semi mature	Typical - upright	Good	Nil	Low
Jacaranda mimosifolia (Jacaranda)	4	5 to 6 metres	Mature	Stunted /Atypical	Fair to moderate	Nil	Low

AREA: 14

Species	No. present	Height Range	Maturity	Form	Health and vigour	Evidence of wildlife usage	Landscape significance
Magnolia grandiflora cv ('Little Gem' Magnolia Cultivar)	1	3 metres	Semi mature	Typical/up right	Good	Nil	Low
Jacaranda mimosifolia (Jacaranda)	5	5 to 9 metres	Mature	4 of 5 suppressed and stunted by salt laden exposure; 1 x typical - upright	4 x Moderate health 1 x Good health	Nil	4 x Low 1 x Moderate to high
Livistona australis (Cabbage Tree Palm)	2	6 to 7 metres	Mature		Good	Nil	Moderate

AREA: 15

Species	No. present	Height Range	Maturity	Form	Health and vigour	Evidence of wildlife usage	Landscape significance
Jacaranda mimosifolia (Jacaranda)	3	7 to 9 metres	Mature	1 x suppressed salt exposure winds 2 x good upright/ typical	Good	Nil	1 x Moderate 2 x Moderate to high
Livistona australis (Cabbage Tree Palm)	2	8 to 9 metres	Mature	Typical/ upright	Good	Nil	Moderate



APPENDIX B: TREE DATA SUMMARY FOR PEPPER TREES 1 - 8

INSERT TREE DATA SUMMARY AT THIS PAGE

APPENDIX C: IACA RATING SYSTEM FOR TREE SIGNIFICANCE

Rating System for Tree Significance

The landscape significance of a tree is an essential criterion to establish the importance that a particular tree may have on a site. However, rating tree significance becomes subjective and difficult to ascertain in a consistent and repetitive fashion due to assessor bias. It is therefore necessary to have a rating system utilising structured qualitative criteria to assist in determining the retention value for a tree. This rating system will assist in the planning processes for proposed works, above and below ground where trees are to be retained on or adjacent a development site.

Once the landscape significance of an individual tree has been defined, the retention value can then be determined.

The terms used in the Assessment Criteria and Tree Retention Value - Priority Matrix, are taken from the IACA Dictionary for Managing Trees in Urban Environments 2009.

Tree Significance - Assessment Criteria

1. High Significance in landscape

- The tree is in good condition and good vigour;
- The tree has a form typical for the species;
- The tree is a remnant or is a planted locally indigenous specimen and/or is rare or uncommon in the local area or of botanical interest or of significant age;
- The tree is listed as a Heritage Item, Threatened Species or part an Endangered ecological community or listed on Councils significant Tree Register;
- The tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape due to its size and scale and makes a positive contribution to the local amenity;
- The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values;
- The growing environment supports the tree to its full dimensions above and below ground without conflict or constraint.

2. Medium Significance in landscape

- The tree is in fair-good condition and good or low vigour;
- The tree has form typical or atypical of the species;
- The tree is a planted locally indigenous or a common species with its taxa commonly planted in the local area
- The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street,
- The tree provides a fair contribution to the visual character and amenity of the area,
- The tree is moderately constrained by above or below ground influences of the built environment to reach full dimensions.

3. Low Significance in landscape

- The tree is in fair-poor condition and good or low vigour;
- The tree has form atypical of the species;
- The tree is not visible or is partly visible from surrounding properties as obstructed by other vegetation or buildings,
- The tree provides a minor contribution or has a negative impact on the visual character and amenity of the area,
- The tree is a young specimen which may or may not have reached dimension to be protected by local Tree Preservation orders or similar protection mechanisms and can easily be replaced with a suitable specimen,
- The tree is severely constrained by above or below ground influences of the built or natural environment and therefore will not reach full dimensions - tree is inappropriate to the site conditions,
- The tree is listed as exempt under the provisions of the local Council Tree Preservation Order or similar protection mechanisms,
- The tree has a wound or defect that has potential to become structurally unsound.

Environmental Pest / Noxious Weed Species

- The tree is an Environmental Pest Species due to its invasiveness or poisonous/ allergenic properties,
- The tree is a declared noxious weed by legislation.

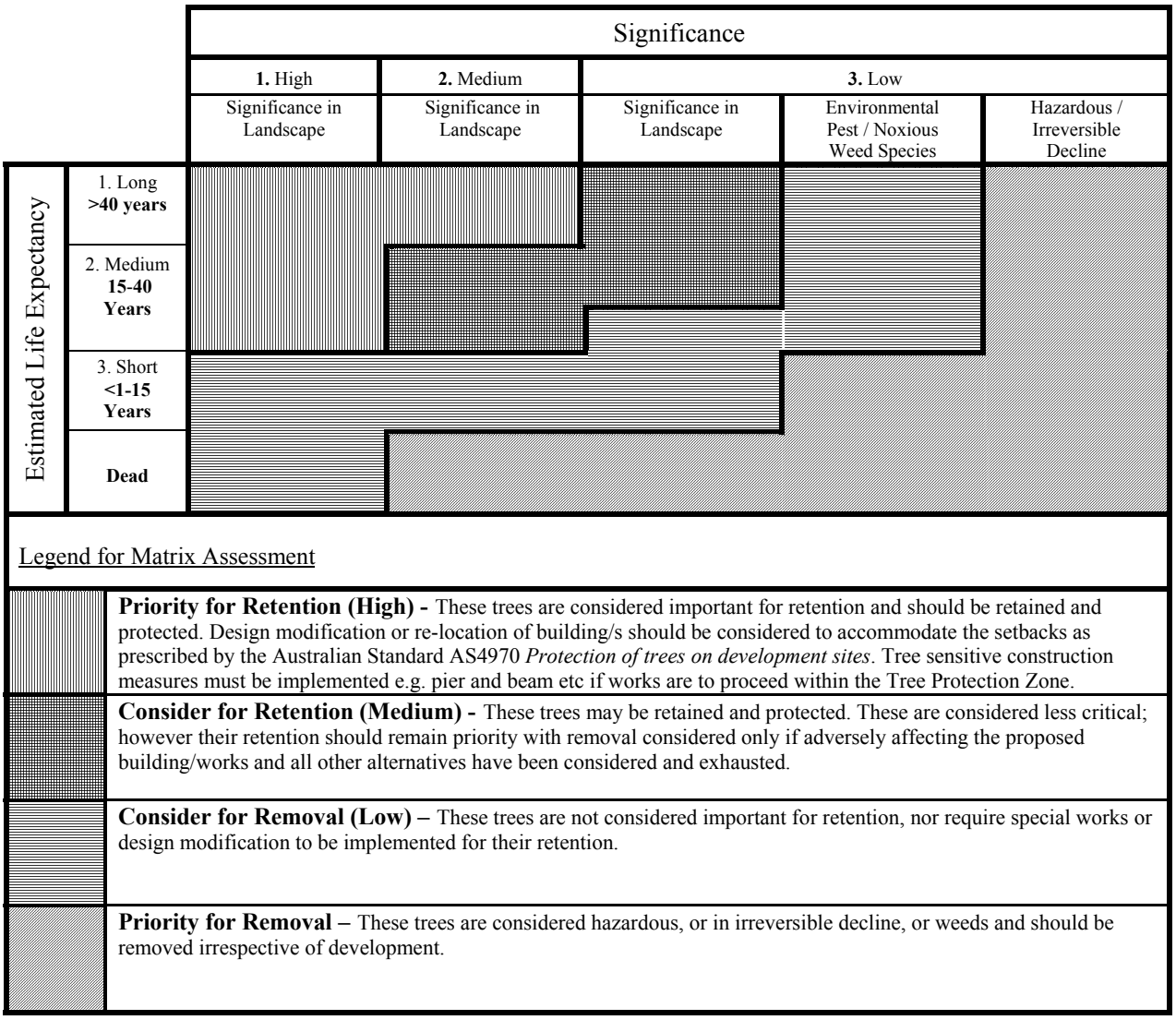
Hazardous/Irreversible Decline

- The tree is structurally unsound and/or unstable and is considered potentially dangerous,
- The tree is dead, or is in irreversible decline, or has the potential to fail or collapse in full or part in the immediate to short term.

The tree is to have a minimum of three (3) criteria in a category to be classified in that group.

Note: The assessment criteria are for individual trees only, however it can be applied to a monocultural stand in its entirety e.g. hedge.

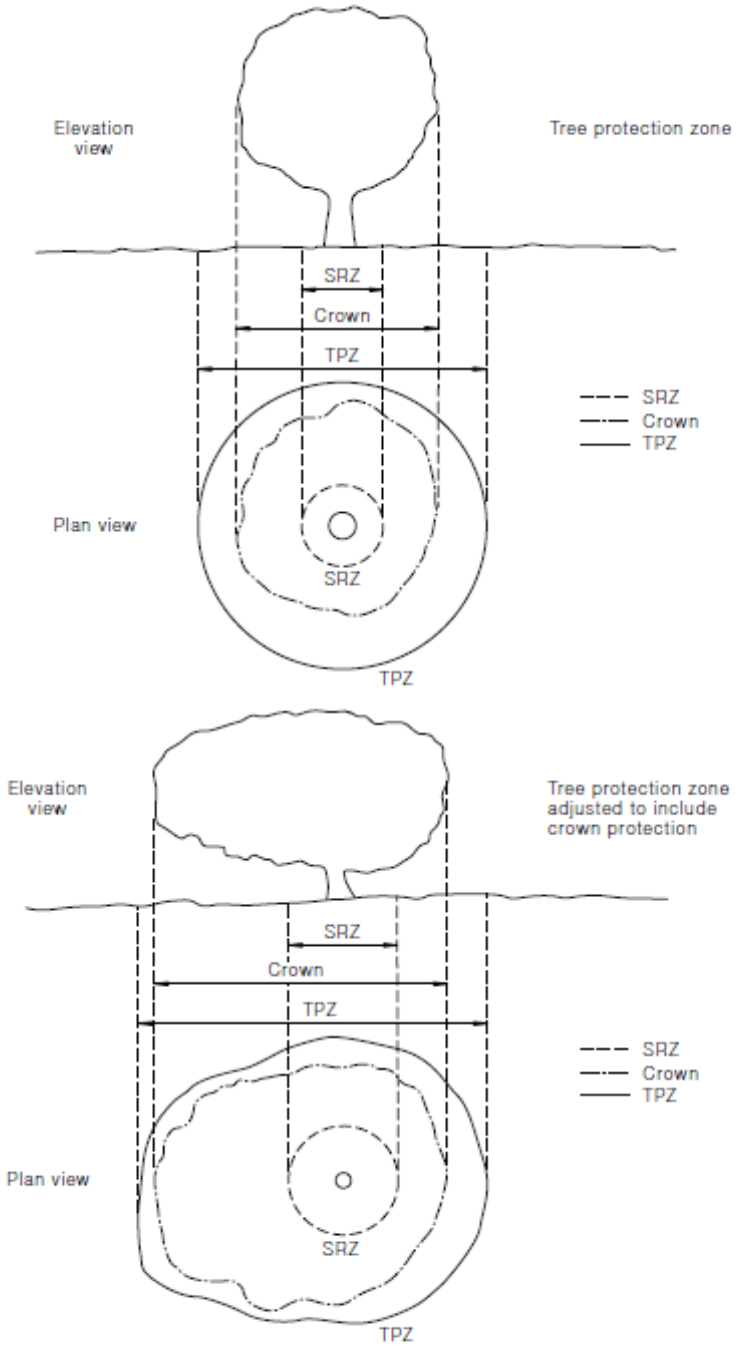
Table 1.0 Tree Retention Value - Priority Matrix.



Legend for Matrix Assessment

	Priority for Retention (High) - These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by the Australian Standard AS4970 *Protection of trees on development sites*. Tree sensitive construction measures must be implemented e.g. pier and beam etc if works are to proceed within the Tree Protection Zone.
	Consider for Retention (Medium) - These trees may be retained and protected. These are considered less critical; however their retention should remain priority with removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.
	Consider for Removal (Low) – These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.
	Priority for Removal – These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.

APPENDIX D: TREE PROTECTION ZONE ILLUSTRATION AS PER AS4970-2009



NOTE: Refer to Clause 3.2 for calculation of TPZ.

FIGURE 2 INDICATIVE TREE PROTECTION ZONE

Source: Australian Standards (2009

APPENDIX E: TREE PROTECTION PLAN
PEPPER TREES NUMBERED 1 TO 4

1. TREE PROTECTION FENCING

Tree protection fencing is to be in accordance with the requirements identified in figure 3 in AS 4970-2009 Protection of trees on development sites. The tree protection fence shall be constructed of galvanised posts at 2.4 metre spacing and connected by securely attached chain mesh fencing to a minimum height of 1.8 metres. Shade cloth (if required) is to be attached to the wire mesh. The galvanised posts are to be held in place with concrete feet.

Tree protection fencing location has been added to the site plan prepared by Rain Tree Consulting on the attached Appendix D.

1.1 Activities Prohibited in Tree Protection Zones

The following activities/actions are prohibited within the fenced area of the identified tree protection zones in accordance with AS4970-2009:

- machine excavation including trenching;
- excavation for silt fencing;
- cultivation;
- storage;
- preparation of chemicals, including preparation of cement products;
- parking of vehicles and plant;
- refuelling;
- dumping of waste;
- wash down and cleaning of equipment;
- placement of fill;
- lighting of fires;
- soil level changes;
- temporary or permanent installation of utilities and signs, and
- physical damage to the tree.

1.2 Tree Protection Fencing, Trunk, Branch and Ground Protection

The Tree protection fencing and ground protection is to be installed prior to commencement of any works on the site (including demolition of structures and removal/pruning of trees) for tree numbers 1, 2, 3 and 4.

Tree protection fencing is to be in accordance with the requirements identified in figure 3 in AS 4970-2009 Protection of trees on development sites and as illustrated in Attachment A. The tree protection fence shall be constructed of galvanised posts at 2.4 metre spacing and connected by securely attached chain mesh fencing to a minimum height of 1.8 metres. Shade cloth (if required) is to be attached to the wire mesh. The galvanised posts are to be held in place with concrete feet.

The tree protection zone is to be identified by signs placed around the edge of the TPZ which are visible from within the development site. The lettering on the sign will comply with AS 1319 and include the following wording 'Tree Protection Zone - Access Prohibited'.

Trunk and ground protection is to be in accordance with the requirements identified in figure 4 in AS 4970-2009 Protection of trees on development sites and as illustrated in Attachment B.

Under no circumstances are tree trunks or branches to be used for the purpose of stays or temporary supports for temporary powerlines, guys, stays etc.

2. EXCAVATION WITHIN TREE PROTECTION ZONES

Where possible, excavation within tree protection zones of trees to be retained is to be avoided.

Where excavation within the tree protection zones of trees to be retained the recommended techniques are use of an airspade/air knife or pressure water jet under the supervision of the site arborist. In compacted sections unable to be excavated by air knife or water jet these sections will be excavated by hand under the supervision of the arborist using small hand tools.

Roots greater than 25mm exposed during excavation are not to be damaged or severed without prior assessment by the site arborist to determine likely level of impact and the restorative actions required to minimise the impacts of root damage.

3. LOCATION AND INSTALLATION OF SERVICES

Wherever possible services are to be located outside the tree protection zones of trees to be retained and are to be within the service corridor identified in Appendix A.

If greater than 10% of the tree protection zone is to be impacted by trenching for services the excavation shall be undertaken using technology that minimises damage to roots such as an airspade/air knife or pressure water jet under the supervision of the site arborist. In compacted sections unable to be excavated by air knife or water jet these sections will be excavated by hand under the supervision of the arborist using small hand tools.

If services are to be installed in the vicinity of a tree's identified structural root zone the installation is to be undertaken using 'trenchless technology' such as thrust boring.

4. CANOPY AND ROOT PRUNING

4. 1 Canopy Pruning

All pruning works required to facilitate approved construction works and site access are to be identified and undertaken prior to commencement of any works on site (including demolition works) to avoid potential conflicts between tree canopies and machinery (and potential mechanical damage arising from such conflicts).

Tree pruning works are to be undertaken by an AQF level 3 arborist and the work shall be carried out in accordance with AS4373:2007 *Pruning of Amenity Trees* and the WorkCover NSW *Code of Practice for the Amenity Tree Industry.*

4. 2 Root Pruning

Roots greater than 25mm are not to be damaged or severed without prior assessment by the site arborist to determine likely level of impact and the restorative actions required to minimise the impacts of root damage.

Roots between 10mm and 25mm diameter, severed during excavation, shall be cut cleanly by hand under the supervision of the site arborist.

All tools used for root pruning shall be sharp implements such as secateurs, lopping pruners or pruning saws. All root pruning equipment shall be sterilized before usage at the site and between use on different trees at the site.

Immediately following pruning all roots are to be covered by moist hessian or equivalent to prevent drying out and desiccation. The hessian is to be maintained in moist condition until installation of permanent cover or backfilling of the trench/excavation with suitable soil is undertaken.

5. INSTALLATION OF SEDIMENT CONTROL FENCING

Silt fencing on construction sites is commonly shown to be buried via a 200mm excavation to secure the sediment fabric. This has the potential for high levels of disturbance to finer absorptive roots in the upper soil profile - within the protection zones of trees to be retained the sediment fence must be installed without excavation and secured by a combination of pegging and sand placed at grade over the sediment fabric to hold the fabric in place.

Where it is not possible to secure the silt fence at grade within the protection zone of any tree any proposal to secure the silt fencing by excavation in the upper soil profile is to be referred to the site arborist for consideration and approval prior to works proceeding.

6. TREE REMOVAL

All tree removals are to be undertaken in accordance with the relevant consent. The contractor undertaking the tree removals is responsible for ensuring the relevant consents have been given, and a copy of the consent(s) are available on site, prior to undertaking the works.

Tree removals are to be undertaken by an AQF level 3 arborist and the work shall be carried out in accordance with AS4373:2007 *Pruning of Amenity Trees* and the WorkCover NSW *Code of Practice for the Amenity Tree Industry.*

The stumps of trees that have been removed are not to be 'grubbed out' or removed by machinery where those stumps are within the tree protection zone of a tree or trees to be retained.

Stumps within the tree protection zone of a tree or trees to be retained can be ground down to 100mm below natural soil surface under the supervision of the site arborist.

7. TREE DAMAGE

All incidents of mechanical damage to tree branches or trunks (or disturbance within tree protection zones) is to be reported immediately (within 1 hour verbally, and 8 hours by email or text message) to site arborist.

The damage or disturbance is to be to be inspected by the site arborist and remedial action commenced within 48 hours. Where the site arborist is prevented from attending during this period the site arborist is to nominate an alternate AQF 5 arborist to undertake the inspection and arrange any required remedial/repair works.

8. FOOTINGS WITHIN TREE PROTECTION ZONES

Supports for the driveway are to comprise isolated piers located by air knife or pressure water jet under the supervision of the site arborist and are to be placed to avoid the need to damage or remove any roots greater than 25mm in diameter.

9. MONITORING AND CONTROL

Prior to commencement of any works at the site, including demolition works, a site arborist for the project is to be appointed.

The site arborist must be suitably qualified and experienced for the requirements of the project. The qualifications and experience required for this project are as follows:

- Australian Qualification Framework (AQF) Level 5 qualifications in arboriculture;
- Demonstrated experience in successful monitoring, supervision and certification of the arboricultural requirements of a project of equivalent scale and complexity; and
- Ability to satisfy relevant Occupational, Health and Safety (OH&S) requirements (e.g. construction induction or 'White' card).

Prior to commencement of any works on site (including demolition and tree removal/pruning) the appointed site arborist is to arrange a 'Site Induction' training session with the construction manager to explain the purpose and scope of this tree protection plan and its requirements.

Inspection and certification of tree protection measures is to be arranged by the project/site or construction manager and undertaken by the appointed site arborist at the times/project stages as identified in table 2:

Table 3: Inspection and certification program

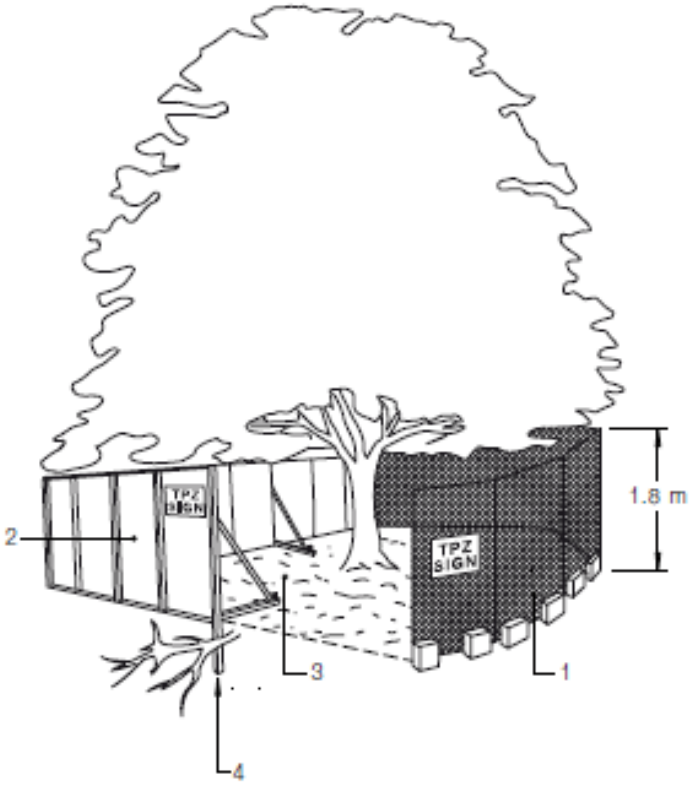
Timing	Purpose	Responsibility
During excavation for determination of pier locations	To certify pier locations will not impact on roots greater than 25mm in diameter	To be arranged by site or construction manager in consultation with the appointed site arborist
Following installation of tree protection fencing and prior to any works commencing on site*	To certify fencing is installed in accordance with specifications	To be arranged by site or construction manager in consultation with the appointed site arborist
Tri monthly intervals from commencement of works until completion of driveway construction works	To check health/vigour of trees and certify protection measures are being maintained in accordance with this plan	To be arranged by site or construction manager in consultation with the appointed site arborist
At completion of driveway construction works	To check condition/vigour of trees and certify protection measures were maintained in accordance with specifications	To be arranged by site or construction manager in consultation with the appointed site arborist and undertaken by site arborist

*This inspection identified as a hold point where further works cannot proceed until the inspection has been undertaken and certified as satisfactory by the appointed site arborist.

The site arborist is to provide written documentation to the Construction Manager following all inspections identified in table 4. The written documentation is to be in the form of a compliance or certification letter and shall specify the following (as a minimum):

- The date of inspection;
- The purpose of the inspection;
- The outcome of the inspection;
- Compliance with the requirements of this plan; and
- Rectification works if required.

ATTACHMENT A: TREE PROTECTION FENCING REQUIREMENTS



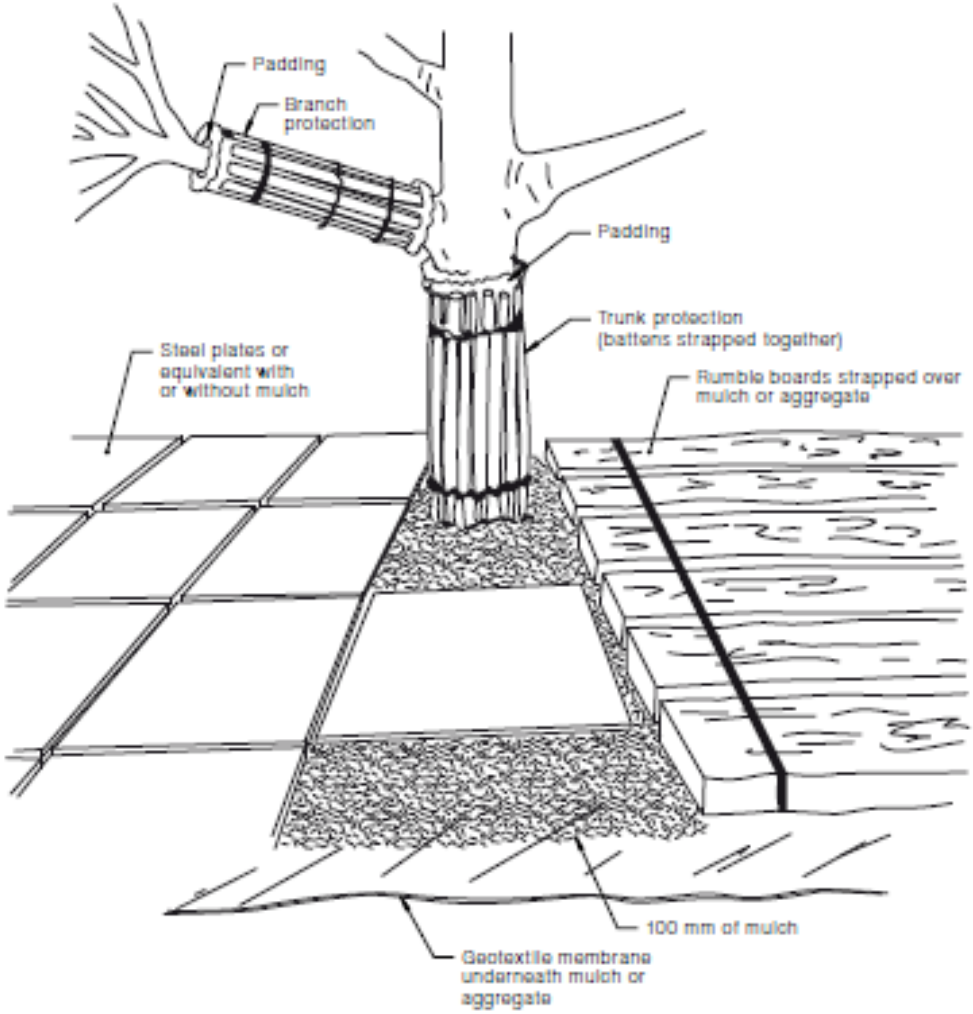
LEGEND:

1 Chain wire mesh panels with shade cloth (if required) attached, held in place with concrete feet.
2 Alternative plywood or wooden paling fence panels. This fencing material also prevents building materials or soil entering the TPZ.
3 Mulch installation across surface of TPZ (at the discretion of the project arborist). No excavation, construction activity, grade changes, surface treatment or storage of materials of any kind is permitted within the TPZ.
4 Bracing is permissible within the TPZ. Installation of supports should avoid damaging roots.

FIGURE 3 PROTECTIVE FENCING

Source: Australian Standards Association 2009

ATTACHMENT B: TRUNK AND GROUND PROTECTION REQUIREMENTS



NOTES:

1 For trunk and branch protection use boards and padding that will prevent damage to bark. Boards are to be strapped to trees, not nailed or screwed.

2 Rumble boards should be of a suitable thickness to prevent soil compaction and root damage.

FIGURE 4 EXAMPLES OF TRUNK, BRANCH AND GROUND PROTECTION

Source: Australian Standards Association 2009